



Goddard Procedural Requirements (GPR)

DIRECTIVE NO.	<u>GPR 8710.3D</u>	APPROVED BY Signature:	<u>Original Signed By</u>
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EXPIRATION DATE:	<u>June 18, 2023</u>	TITLE:	<u>Director, Safety and Mission Assurance</u>

COMPLIANCE IS MANDATORY

Responsible Office: 360/Safety Division

Title: Certification and Recertification of Ground-Based Pressure Vessels and Pressurized Systems (PVS)

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PREFACE

P.1 PURPOSE

This document establishes the process, requirements and responsibilities for the Goddard Space Flight Center (GSFC) PVS Program to provide Center organizations with the certification and consultation of ground-based PVS by implementing the requirements of NPD-8710.5 and NASA-STD-8719.17.

This document is not a substitute for applicable Federal, State, and Local requirements. The Occupational Safety and Health Administration (OSHA) requirements apply to all GSFC PVS.

P.2 APPLICABILITY

- a. This document is applicable to all ground-based PVS at GSFC Facilities including Greenbelt, Wallops Flight Facility (WFF), and other facilities under GSFC cognizance unless specifically excluded by this document or by the Pressure Systems Manager (PSM).
- b. When invoked as a contractual requirement by the applicable project, this document is applicable to PVS at off-site contractor installations supporting GSFC projects.
- c. When requested by the initiating organization, the responsible contracting officer and the PSM shall decide if non-NASA owned PVS used in non-NASA operations poses a risk to NASA personnel, facilities, or equipment in order to apply this document to any contractor or tenant.
- d. In this directive, all document citations are assumed to be the latest version unless otherwise noted.
- e. In this directive, all mandatory actions (i.e., requirements) are denoted by statements containing the term “shall.” The terms “may” or “can” denote discretionary privilege or permission; “should” denotes a good practice and is recommended but not required; “will” denotes expected outcome; and “are/is” denotes descriptive material.

P.3 AUTHORITY

NPD 8710.5, Safety Policy for Pressure Vessels and Pressurized Systems

P.4 APPLICABLE DOCUMENTS AND FORMS

- a. NPD 8710.5, Safety Policy for Pressure Vessels and Pressurized Systems
- b. NPR 8715.3, NASA General Safety Program Requirements
- c. NASA-STD-8719.17, NASA Requirements for Ground-Based Pressure Vessels and Pressurized Systems (PVS)
- d. GPR 1400.1, Waiver Processing

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- e. GPR 8710.7, Cryogenic Safety
- f. GPR 8621.4, GSFC Mishap Preparedness and Contingency Plan
- g. 360-PG-8710.0.2, High Pressure Systems Operator Certification
- h. 800-PG-8710.3.1, Wallops Flight Facility Flex Hose Handling and Installation
- i. GSFC-STD-8006, Safety for Ground Piping Systems Color Coding and Identification
- j. KSC-STD-Z-0006, Design of Hypergolic Propellants Ground Support Equipment
- k. American Society for Mechanical Engineers (ASME) A13.1, Scheme for the Identification of Piping Systems
- l. ASME B31.3, Power and Process Piping Package
- m. American Society for Nondestructive Testing (ASNT) *Recommended Practice No. SNT-TC-1A*, Personnel Qualification and Certification in Nondestructive Testing
- n. ASNT CP-189, ASNT Standard for Qualification and Certification of Nondestructive Testing Personnel

P.5 CANCELLATION

GPR 8710.3C, Certification and Recertification of Ground-Based Pressure Vessels and Pressurized Systems

P.6 SAFETY

Detailed safety requirements are contained in applicable procedures and throughout this document.

P.7 TRAINING

- a. Supervisors, project managers, or designees shall ensure that PVS personnel (i.e. PVS Operators) are skilled, qualified and certified (when applicable) to perform their role safely and effectively, based on training, prior experience, and physical abilities.
- b. Specific training requirements for PVS high pressure operator licensing are specified in 800-PG-8710.3.1 and this document.

P.8 RECORDS

Record Title	Record Custodian	Retention
Test & Inspection Reports for PVS	PSM or designee	*NRRS 1/118A. Retire to FRC or approved storage facility when 5 years old. Destroy no earlier than when 25 years old.
PVS Certification Reports	PSM or designee	*NRRS 1/118A.

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Training Records	PVS Owner/Supervisor	*NRRS 3/33C. Destroy or delete 5 years after separation of employee or when no longer needed, whichever comes first
PVS Operation documentation	PVS Owner/Supervisor	*NRRS 1/118A
Transient and Temporary PVS Documentation	PSM or designee	*NRRS 1/118A

*NRRS – NASA Records Retention Schedules ([NRRS 1441.1](#))

P.9 MEASUREMENT/VERIFICATION

Appropriate data, which may include information derived from activities specified in paragraph 2.4 (e.g., number of deficiencies/discrepancies identified, time to complete corrective actions, number of waivers generated, etc.), the results of audits and mishap investigations (including tracking of appropriate follow up actions) and analysis of trends, shall be captured and analyzed to measure the performance of GSFC PVS operations.

PROCEDURES

1. Responsibilities

Responsibilities shall be in accordance with NPD 8710.5 and the responsibilities stated within this document.

1.1 Installation Director:

Shall appoint the PSM for GSFC-Greenbelt (GB) and for GSFC-Wallops Flight Facility (WFF).

1.2 Pressure Systems Manager:

The PSM is the Technical Authority (TA) responsible for the management, implementation, and enforcement of the Center's PVS Program. The PSM is also responsible for oversight, for safety and for use and compliance of all PVS, including temporary or transient PVS, on site.

1.2.1 The PSM Shall:

- a. Serve as the Technical Authority for the certification and recertification of ground based PVS to which this document is applicable and serve as the final authority on interpretation of, and compliance with, this document and its reference documents;

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- b. Review and concur/non-concur with safety waiver requests regarding PVS per GPR 1400.1 prior to the originator's submittal to the appropriate chain-of-authority, which may also include the GSFC Director, for approval; and
- c. Establish and maintain a PVS Program configuration management system, facilitate requesting authorities regarding the need to understand the status of particular PVS and provide PVS owners with a current PVS inventory.

1.2.2 The PSM Should:

- a. Provide assistance to PVS owners in the identification and assessment of risks posed by their PVS, and document the associated Risk Assessment Code (RAC) in the PVS Configuration Management (CM) system;
- b. Perform compliance spot checks of PVS to ensure that the requirements of this document and NASA-STD-8719.17 are being followed; and
- c. Maintain a baseline inventory for all PVS for which GSFC has responsibility.

1.2.3 The PSM May:

- a. Approve extension for any In-Service Inspections (ISI) that cannot be completed by the ISI due date due to testing, system availability or other acceptable rationale as determined by the PSM.

1.2.4 The PSM Will:

- a. Serve as the GSFC interface with NASA Headquarters and other NASA Centers on matters pertaining to PVS;
- b. Review and concur/non-concur with specifications/designs prior to procurement of PVS;
- c. Serve as the GSFC representative on the NASA PVS Working Group; and
- d. Coordinate reviews of cryogenic systems with the Cryogenic Safety Engineer in accordance with GPR 8710.7.

1.3 PVS Owner:

1.3.1 The PVS Owner Shall:

- a. Comply with this document and NASA-STD-8719.17;

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- b. Ensure that the design, fabrication, assembly, erection, inspection, examination, and testing of new PVS, and that alterations/modifications and repairs to existing PVS are in compliance with the requirements of this document and NASA-STD-8719.17;
- c. Ensure that the design of new PVS, or proposed alterations of modifications to existing PVS are submitted to the PSM for compliance review prior to procurement and request the PSM to certify the PVS when installation, modifications, or alterations are complete;
- d. Comply with GPR 8710.7 for systems operating at cryogenic temperatures.
- e. Notify the PSM in advance of any temporary or transient PVS that may pose risk to NASA personnel or equipment so that applicability of PVS Program requirements may be determined;
- f. Ensure the PVS is inspected and tested in accordance with the ISI schedule as called out in the system certification;
 - (1) Inspection and test reports will be submitted to the PSM for record retention and verification of continued certification;
- g. Initiate and process the appropriate Incident/Mishap Report in accordance with GPR 8621.4;
- h. Ensure that PVS are operated within the certification parameters;
- i. Develop and maintain operating procedures for specific PVS;
- j. Submit hazardous operating procedures, as defined in NPR 8715.3, to the installation's safety organization for approval prior to use of PVS;
- k. Ensure that new, modified, repaired, relocated, or transferred PVS are certified or recertified prior to use;
- l. Remove PVS from service when required by the PSM. Alternatively, a variance may be processed in accordance with Section 3 of this document in order to resume operation of the PVS until the deficiencies can be corrected; and
- m. Route waivers as stipulated in GPR 1400.1.

1.3.2 The PVS Owner Should:

- a. Maintain PVS and their components in accordance with the manufacturer's recommendations or with a prescribed in service inspection plan to ensure continued compliance with the certification or

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recertification (In some cases, due to operational, environmental, or other parameters, maintenance procedures in addition to the manufacturer's recommendations may be necessary).

- b. Submit requirements to the appropriate budget to bring PVS into compliance with this document;
- c. Initiate repair of PVS deficiencies discovered during ISI, and notify the PSM upon completion of corrective actions;
- d. Notify the PSM of any PVS that is removed from service;
- e. Provide and maintain training, training records and operational procedures for specific PVS;
- f. Perform compliance spot checks to verify operations are conducted within the operational parameters of the PVS; and
- g. Notify the PSM immediately of all PVS deficiencies or anomalies and perform corrective actions as recommended by the PSM.

1.3.3 The PVS Owner Will:

- a. Ensure that all applicable documentation listed in Appendix C of this document is furnished to the PSM for certification prior to operation of new, modified, altered, repaired, or transferred PVS. The supply of such documentation should be made a part of any PVS procurement;
- b. Control uncertified PVS to preclude inadvertent use;
- c. Maintain responsibility for day-to-day operations of PVS under their cognizance;
- d. Ensure that any research and development or test and evaluation activities conducted within or in association with a PVS will not adversely impact the structural integrity or safety of the PVS; and
- e. Ensure that PVS are operated and maintained by adequately trained and qualified personnel.

1.4 PVS Operator and Operator Management:

In addition to the responsibilities of the PVS Owner:

1.4.1 The PVS Operator and Operator Management Shall:

- a. Cease operations in the event of an actual or reported failure or unsafe condition and only resume operations after failures or unsafe conditions have been properly addressed and/or corrected; and

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- b. Follow the requirements of 360-PG-8710.0.2 for certification of High Pressure Operators.

1.4.2 The PVS Operator and Operator Management Should:

- a. Notify the PSM immediately of any PVS deficiencies or anomalies and perform corrective actions as recommended by the PSM.

1.4.3 The PVS Operator and Operator Management Will:

- a. Operate PVS following an operating procedure for a specific PVS;

1.5 Facility Management Division (FMD):

1.5.1 The FMD Shall:

- a. Adhere to applicable PVS Owners and Operators responsibilities;
- b. Notify the PSM, in writing, of any planned PVS acquisition, installation, modification/upgrade or removal as part of a FMD project; and
- c. Provide all new PVS designs and specifications, including alteration plans to existing PVS, to the PSM for review and approval prior to contract implementation.

2. PVS Program Requirements

- a. Ground-based PVS are included in the PVS Program and are subject to formal certification and re-certification with the exception of those PVS delineated by the exclusion section in NASA-STD-8719.17.
- b. In addition to the exclusion criteria set forth in NASA-STD-8719.17, control, shop air, or inert gas piping systems with stored energy levels exceeding 14,240 foot-pounds shall be included in the PVS program.

2.1 PVS Certification and Recertification

- a. PVS shall be certified and recertified by the PSM in accordance with NASA-STD-8719.17 and this document.
- b. Certification/Recertification shall be based upon verification and acceptance of design, fabrication, material, service, inspection and testing as applicable. Each certification/recertification should be customized to meet the needs of the individual system.

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- c. All new and modified PVS will be certified prior to entering service, after compliance with NASA-STD-8719.17 and this document is verified by the PSM.
- d. PVS operating at cryogenic temperatures shall be reviewed and approved in accordance with GPR 8710.7 prior to certification and recertification.
- e. Formal notification of PVS certification, including all applicable constraints and schedules, will be made by the PSM to the owning organization and documented in the configuration management system.
- f. A prioritized listing of systems within the scope of the program based on factors such as stored energy, exposure to personnel, mission criticality, age and other relevant factors shall be kept and updated as necessary to maintain system priority and system count.

2.1.1 System Integrity Assessment

- a. An engineering assessment and PVS mechanical integrity analysis, including a remaining life assessment, shall be performed before the start of the first certification period.
- b. The engineering/mechanical integrity assessment of design calculations (pressure design, flexibility and support analysis, etc.), fabrication, materials, service, inspection and testing shall be evaluated in accordance with the latest codes, standards, regulations and requirements specified in this document and NASA-STD-8719.17.
- c. Documentation requirements will vary depending on complexity and service of the PVS, guidelines for documentation are found in Appendix C of this document.
- d. Verification of pressure and temperature ratings and commodity compatibility shall be performed and appropriately documented to ensure all portions of the PVS are acceptable in relation to operating conditions.
- e. Hypergolic fluid PVS shall be assessed in accordance with applicable NASA documents including KSC-STD-Z-0006, Design of Hypergolic Propellants Ground Support Equipment.
- f. When hypergolic fluid or vapor are present in a PVS, material compatibility shall be assessed in accordance with 79K11948, Material Selection List for Type J Fluid Service and AIAA SP-085-1999 in lieu of more applicable data.
- g. Oxidizer systems such as Oxygen and Nitrous Oxide shall be assessed in accordance with ASTM MNL-36: Safe Use of Oxygen in lieu of more applicable data.
- h. Each PVS shall be maintained in the Center's PVS configuration management system.

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- i. Manufacturer's technical literature shall be used to establish pressure and temperature limits of individual components, including piping and tubing, and to determine if National Consensus Codes and Standards (NCS) are met in the component design.
- j. If manufacturer technical literature cannot be obtained, equivalent documentation by engineering analysis using applicable NCS or testing in accordance with American Society of Mechanical Engineers (ASME) shall be performed.
- k. If the initial integrity assessment and/or initial Non-Destructive Examination and testing (NDE) indicates deficiencies such as inadequately rated components installed in the system, recommendations shall be made to the PVS owner to ensure compliance through a repair plan, replacement or de-rating of the system.
- l. An initial visual inspection shall be performed of the entire PVS for signs of cracks, corrosion, leakage, excessive vibration, missing fasteners, broken supports or other surface defects.
- m. Documentation of all repair work including statement of work, photographs, description, inspections reports, etc. shall be entered into the configuration management system for record retention.
- n. An ISI plan in accordance with section 2.2 of this document and NASA-STD-8719.17 shall be developed to monitor all relevant degradation mechanisms associated with the system.

2.2 In-Service Inspection

- a. In order to maintain certified status, PVS shall be subject to ISI as described in the ISI schedule and as called out in the system certification package located in the PVS configuration management system.
- b. The PVS owner or PVS owner's delegation shall perform the required ISI or contract the required ISI to qualified personnel to perform the defined ISI of the certified system.
- c. Personnel performing Nondestructive Examination (NDE)/ Nondestructive Testing (NDT) of GSFC PVS shall be adequately trained by a program that meets the requirements of American Society for Nondestructive Testing (ASNT) SNT-TC-1A or ASNT CP-189.
- d. The PVS owner shall provide the PVS ISI reports to the PSM to ensure certification of the system is maintained.
- e. All ISI reports shall be entered into the PVS configuration management system for records retention.

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- f. If the required ISI as called out in the system certification package cannot be completed by the ISI due date, an extension can be requested in accordance with NASA-STD-8719.17.
- g. If at any time a PVS is not fit for the intended service, the PVS shall be removed from service immediately by its owner/operator.
- h. If at any time a PVS is not fit for the intended service, certification of the PVS shall be revoked.
- i. Discrepancies or deficiencies resulting from ISI will be documented and reported to the PVS owner. The owner shall provide a discrepancy correction plan to the PSM detailing the corrective actions to be taken and the schedule for accomplishing the actions. Unless specifically approved by the PSM, all discrepancies should be resolved prior to the next scheduled ISI.
- j. Disregard of maintenance or inspection may be cause for revocation of the certification at the discretion of the PSM.
- k. Baseline thickness shall be verified for all PVS subject to wall thinning as a limiting damage mechanism prior to initial operation or certification.
- l. Ultrasonic Thickness Testing spot checks shall be performed to confirm adequacy of components located in a system.
- m. Recommendations from the manufacturer of pressure system components and recommendations resulting from failure modes and analysis should be incorporated in the ISI as necessary.

2.3 Risk Assessment

- a. A risk assessment shall be conducted for each pressure system in accordance with NASA-STD-8719.17 and this document.
- b. The risk assessment shall identify all credible hazards associated with the environment and operation of the PVS in terms of likelihood of failure and severity of consequence.
- c. Throughout the life of each PVS, risk assessments shall be maintained and updated as necessary through PVS ISI or due to a change in the system that requires recertification.

2.4 PVS Process and Instrumentation Diagrams

- a. Process and Instrumentation Diagrams (P&ID) are required for certification/recertification of PVS to properly document the interconnection of equipment in the piping system.

- b. P&ID's shall be end to end and show at a minimum the maximum allowable working pressures and operating pressures of each section of the PVS, relief device set points, line sizes and schedule/wall thickness of piping and tubing, commodity, title block, legend, location key, field verification date, revision block, and P&ID border with zones for location call out.
- c. A Bill of Materials shall contain full part numbers traceable to the original manufacturer to identify components, manufacturer name, component size, component type and pressure rating for all components in a non-excluded portion of a PVS.
- d. P&ID's shall clearly label system boundaries.
- e. P&ID's shall clearly show set points of all safety devices including relief devices and safety indicators and switches.
- f. Components that are part of an excluded portion of a PVS should contain all of the aforementioned information required for non-excluded components.

2.5 Temporary PVS

- a. Temporary PVS shall be in operation for no more than 180 days.
- b. Prior to operation of a temporary PVS, each temporary PVS shall be submitted for review and approval by the PSM.
- c. Documentation that should be submitted to the PSM for review includes operating procedure of PVS, PVS drawings/schematics, parts list or bill of materials, owning organization and duration of testing using the temporary PVS.
- d. Once approved by the PSM, the temporary PVS should receive a temporary PVS tag or other means deemed acceptable by the PSM with an expiration date which does not to exceed 180 days.

2.6 Flight and Airborne PVS

- a. Flight and airborne PVS may be reviewed and approved by the PSM if deemed necessary for ground based testing and integration.

2.7 Permit Plan (PP)

- a. Specific components may be placed under a PVS Permit Plan (PP). The PVS permit plan allows for components not installed in a permanent pressure system to be tracked and properly inspected and maintained in accordance with NASA-STD-8719.17.

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- b. A permit plan number is assigned to a set of components based on the same criteria that is required in assigning a system number, including a set location or lab. The Permit Plan number will begin with the location code, followed by PP (Permit Plan) and the remaining number will follow the PVS naming and tagging convention.
- c. Each component shall be given a unique identifier within the permit plan number to properly identify each component within a specific permit plan.
- d. Permit plan components shall be tracked in the configuration management system as a typical system/component and will include at a minimum location, component information required for certified components, ISI type and ISI due date, test and inspection reports.
- e. The permit plan component shall be tagged and include: Permit Plan Number, Component Unique Identifier, Component Location Building and room if possible, Maximum Allowable Working Pressure (MAWP) of component and the Owning Organization Code.

2.8 Transient PVS

- a. Transient PVS that are received from another NASA center will be certified by that center prior to acceptance at GSFC. If the PVS is not certified by another NASA center prior to arrival at GSFC, the proper paperwork required for certification, as shown in Appendix C, shall be submitted prior to arrival for review and approval by the PSM. Once the system arrives at GSFC, the system must be certified or given temporary certification by the PVS office prior to initial use.
- b. Transient PVS not originating from another NASA Center shall have the required paperwork, as shown below, submitted prior to arrival for review and approval by the PSM.
 - (1) PVS Schematic
 - (2) Parts List or Bill of Materials with manufacturer, model number, pressure and temperature rating information
 - (3) Operating Procedure
 - (4) Proof Test/Leak Test
 - (5) Duration PVS will be on site
 - (6) Relief Valve Test Reports (When applicable)
 - (7) Pressure Gauge Calibration Reports (When applicable)
 - (8) PVS Contact Information
- c. Once the transient PVS is certified or given temporary certification, the PVS will be appropriately labeled and tagged in accordance with the PVS labeling and tagging section of this document.
- d. In either event described above, the PSM has the authority to reject any PVS that does not meet NPR 8715.3, NASA-STD-8719.17 or this document.

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- e. NASA and Non-NASA personnel should be adequately trained to operate the transient PVS. All personnel should complete high pressure operator training in accordance with 360-PG-8710.0.2 or PSM approved equivalent for operation of PVS here at GSFC.
- f. Transient PVS related documentation are to be kept in accordance with the document retention requirements addressed in the record retention section of this document.
- g. High Pressure Operators for transient systems must meet the criteria for tenant and/or transient contractors/organizations as stated in 360-PG-8710.0.2.

2.9 PVS Naming, Labeling and Tagging

PVS naming, labeling and tagging will meet the requirements of NASA-STD-8719.17, GSFC-STD-8006 and this document.

- a. PVS naming shall be performed in accordance with GSFC PVS naming procedures;
- b. Non-excluded PVS shall be labeled with its maximum operating pressure and fluid;
- c. Portable and mobile pressure vessels shall be marked in accordance with the applicable DOT specification;
- d. Fixed ground support piping and tubing runs external to regulation and control panels and consoles shall be identified in accordance with ASME A13.1 and GSFC-STD-8006.
- e. Tagging of certified PVS will be performed in accordance with GSFC PVS program tagging procedures;
- f. Certified PVS shall have a system “dog tag” with the unique PVS number, MAWP for each step down of the PVS, owning organization code and recertification date. On the back of the PVS system tag, contact information is given for the PVS Office;
- g. Pressure regulators shall be tagged with a unique identifier, maximum inlet and outlet pressure and ISI due date;
- h. Pressure Relief Devices (PRD) shall be tagged with a unique identifier, set pressure and ISI due date;
- i. Transient and temporary systems should receive a transient/temporary tag for the duration the PVS is assembled at GSFC. The transient/temporary tag will include owner contact information, the project or test specific to the set up and an expiration date.

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2.10 Flexible Hoses

In addition to the flex hose requirements stated in NASA-STD-8719.17 and this document, refer to 800-PG-8710.3.1, Wallops Flight Facility Flex Hose Handling and Installation, for guidelines pertaining to flex hose installation, installation and calculations for flex hose restraints, and acceptable types of flex hose restraints.

- a. Flexible Hoses which are six feet long or greater shall be installed so that restraint is provided on both the hose and adjacent structure at no greater than six-foot intervals and at each end to prevent whipping in the event of a burst.
- b. Restraining devices shall be designed and demonstrated to contain a force not less than 1.5 times the open-line pressure forces, see section 5.2 and table 3 of 800-PG-8710.3.1 for calculating the open line force of a flexible hose.
- c. Universal Bale restraints shall not be used on flexible hoses with an outside diameter of less than ½” or flexible hoses with a working pressure exceeding 3,000 psig.
- d. A hose whose installation and placement are considered an integral part of the PVS installation and are indicated by design-controlled engineering drawings is considered a permanent flex hose. Permanent flex hoses have an assigned drawing reference designator. Permanent hoses are acceptable and are certified as part of the overall PVS in which it is installed. Permanent flex hoses shall be documented as an assessed hazard within each PVS certification or recertification report.
- e. Flexible hoses that are considered a utility hose which is not a permanently installed, mobile, or special purpose hose for use with equipment where the normal working pressure is at 150 psig or below and the hose ID is ½” or less shall be excluded from the requirements of this document so long as the service media is not hazardous, flammable, toxic or cryogenic.

2.11 Specialized Equipment/Components Required for Mission Assurance

For the purpose of this paragraph, the specialized pressure or cryogenic components or systems are equipment that are not meeting national consensus codes and standards requirements for its intended service, but are required to be utilized to ensure mission success. Equipment listed below may be utilized with in the pressure systems or cryogenic systems with safety mitigation to exclude personnel from potential failure during pressurization or flowing of the commodity.

- a. Polytetrafluoroethylene (PTFE) tubing used in cryogenic service such as liquid nitrogen (LN2) for Sounding Rocket program during integration, testing and launch operations.

(1) Length and size of the PTFE tubing shall be minimized.

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- (2) If the PTFE tubing is needed in the integration facility, PTFE tubing shall be covered with sleeve from end to end and mechanically clamped or fastened to ensure tightness of connections.
- (3) Hazard procedure shall clearly state the use of this tubing.
- (4) The hazard procedure shall establish personnel clear radius to eliminate personnel exposure to cryogenic fluid during transfer operations.

2.12 Relief Valves

- a. Proportional relief valves shall not be used as a primary relief device of a PVS.
- b. Relief devices shall be tested by qualified individuals that have attended formal training pertaining to the test and repair of relief devices in accordance with the National Board of Boiler Inspectors.
- c. Pressure relief devices shall only be repaired and certified by national board authorized repair organizations that maintain a current registered VR (Valve Repair) stamp.
- d. Relief device test reports shall be retained in the PVS configuration management system.

2.13 Pressure Regulators

- a. When a two-stage pressure regulator is present in a system, the manufacturer preset inter stage pressure may be used for calculating the required flow rate of the pressure relief device protecting the downstream portion of the system.
- b. The inter stage set pressure of the pressure regulator may be determined by manufacturer documentation or by set pressure of the pressure regulator relief device installed on the inter stage of the pressure regulator.
- c. The relief device installed on the pressure regulator shall not be used to protect the downstream portion of the pressure system.

2.14 Pressure Indicating Devices

- a. If a catastrophic failure of a gauge can cause personnel injury, the pressure gauge shall be equipped with a relief type blow out back.
- b. Pressure gauges installed in a pressure system should have a full-scale pressure such that the operating pressure occurs in the middle third (25% to 75%) of the pressure gauge scale.

2.15 Pressure Testing

- a. All new, repaired, or modified systems or portions thereof, shall be pressure and leak tested prior to activation to verify the integrity of the installation, repair or modification.
- b. Testing of pressure systems shall be in accordance with applicable NCS and equipment technical manuals.
- c. Leaks shall not be repaired when a system is under pressure or the test fluid has not been drained.
- d. All pressure and leak tests shall be conducted using a written procedure with appropriate safety procedures and precautions approved by the PSM.
- e. Temporary systems used for the purpose of pressure testing shall follow the requirements of a temporary system.
- f. Cryogenic vessels and systems may be subject to a cold shock test, at the discretion of the PSM, prior to pressure testing to verify material compatibility, design and to ensure there are no defects present in the vessel or system.

2.16 Personnel Qualification

PVS shall be operated by system owners and/or operators who have received training in the operational characteristics and are knowledgeable of the operational procedures, checklists, inherent hazards and operational limits associated with the PVS.

2.16.1 High Pressure Systems Operators

- a. PVS shall be operated by skilled, adequately trained, and qualified personnel.
- b. Qualified personnel shall be certified In Accordance With 360-PG-8710.0.2, High Pressure Operator Certification.
- c. High Pressure Operator Certification will be maintained in a designated database.

2.16.2 Inspection Personnel Training

- a. Inspection personnel performing Non-Destructive Examinations of pressure systems shall be trained via a program meeting the requirements of the American Society for Nondestructive Testing (ASNT) SNT-TC-1A "Personnel Qualification and Certification in Nondestructive Testing" or ASNT CP-189 "ASNT Standard for Qualification and Certification of Nondestructive Testing Personnel".

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2.17 Procurement

- a. Prior approval for procurement of PVS subject to PVS requirements as stipulated herein must be obtained from the PSM.
- b. Prior approval of PVS or component procurement is not necessary so long as the engineering design and specification has been reviewed and approved by the PSM in accordance with this document.
- c. Credit card holders shall verify that this approval has been obtained prior to making purchases.
- d. Replacement parts or components for maintenance or repair of existing equipment are excluded from this requirement provided that they are identical to the existing parts or components and the fit, form, or function of the original item is not altered.

3. Waivers

- 3.1 Waivers to the requirements of this document shall be prepared and approved as outlined in NASA-STD-8719.17 and GPR 1400.1 prior to operation.
- 3.2 A risk acceptance plan should be developed with supporting information including, but not limited to, operational and maintenance parameters, special constraints or instructions required for safe operation, any special training needs, required personal protective equipment, engineering and procedural controls, and any special inspection requirements.
- 3.3 The safety waivers request package shall be reviewed and the risk accepted by the initiating Division Office and forwarded to the PSM for review and concurrence.
- 3.4 Upon concurrence by the PSM, the waivers shall be routed as stipulated in GPR 1400.1.

Appendix A – Definitions

Most of the terms used in this document are defined in NASA-STD-8719.17 or NPR 8715.3. Those that are unique to this document or those that require amplification for GSFC applications are listed below.

A.1 Alteration – A change in the item described on the original Manufacturer’s Data Report which affects the pressure containing capability of the pressure retaining item. Nonphysical changes such as an increase in the maximum allowable working pressure (internal or external), increase in design temperature, or a reduction in the minimum temperature of a pressure-retaining item is considered to be an alteration.

A.2 Certification - A Center PSM’s formal acceptance, in accordance with NPD 8710.5 and this standard, for operation of a PVS, based on a documented process for assessment of integrity and risk, and compliance with applicable requirements.

Note: Applicable requirements include those found in NASA-STD-8719.17, NPR 5005, applicable laws, statutes, and regulations. Appropriate documentation includes, as a minimum, (1) integrity assessment, (2) currency of periodic components inspections and tests, (3) initial/remaining service life determination, (4) development/update of a periodic inspection plan for use prior to the next certification interval, (5) performance/update of a risk assessment, (6) a statement of certification/recertification status and limitations, including applicable waivers. These assessments are based on a systems engineering approach. A component may be certified for specified parameters, but certification for actual usage is based on its evaluation in a system, with consideration of actual service conditions, including pressure, temperature, flow rates, cycling, environmental factors, etc. Note also that, while this certification by the PSM is required for operation of a non-excluded pressure system, there may also be other Center or Agency requirements (for example, a Facility Readiness Review, or requirements in NASA-STD-5005, Standard for the Design and Fabrication of Ground Support Equipment) that apply.

A.3 Certification Parameters - The parameters that characterize a pressure vessel or system for safe operation at the original design conditions or at reduced design conditions. These parameters include: (a) material, (b) wall thickness, (c) maximum allowable working pressure or maximum design pressure, (d) minimum and maximum temperatures, (e) size and shape of pressure vessel, (f) condition of welds (flaws, penetration, porosity, etc.), pressure cycles, (g), and (h).

A.4 Certification PVS Documentation - Files that are maintained for PVS that include, but are not limited to, a unique PVS identifier, the manufacturer’s/fabricator’s documents, design data, field test data, safety analyses, results of engineering analyses, repair history, facility descriptions, records of safety variances, rerating, and correspondence.

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A.5 Critical PVS – A PVS which could result in loss of life, loss or damage to flight hardware, or a PVS involving spacecraft, one of a kind test articles, or major facility components whose loss would have a serious programmatic or institutional impact.

A.6 Cryogenic Temperature – Temperature below -90°C (-130°F)

A.7 Deficiency – For the purposes of this document, a PVS deficiency is defined as failure of the PVS to meet one or more of its certification parameters. The certification of PVS containing documented deficiencies may be revoked and the PVS may be removed from service up on determination of PSM.

A.8 Discrepancy – For the purposes of this document, a PVS discrepancy is defined as a condition that could lead to a PVS deficiency and revocation of the PVS certification. Examples of PVS discrepancies include deterioration of PVS protective coatings, excessive corrosion on PVS supports, or failure to electrically insulate dissimilar metal joints.

A.9 Division Office – For the purposes of this document, use of the term “Division Office” includes Project Offices, Program Offices, and Laboratories; which own or responsible for PVS.

A.10 Facility Maintenance Division (FMD) – Responsible for planning and directing the center’s overall facilities and maintenance program to provide a physical plant congruent with the needs of its research, development, and operation programs. Administers the construction of facilities, research and development, research operations support and multi program support and maintenance budgets. Coordinates the facility engineering and administrative support required by the GSFC Facilities Coordinating Committee, Health and Safety Committee. Acts as the Center's facility liaison with federal, state, and local government agencies and foreign governmental representatives. Manages the Center's facilities utilization program. Conducts studies and reviews of housing requirements and utilization against approved programs. Provides professional engineering expertise in support of the Center's facility systems, reliability, maintainability, energy management and environmental program. Direct the overall operation and maintenance of facilities, utility systems, grounds, roads, and authorized remote and leased facilities.

A.11 Inspection Plan - Inspections, examinations or tests to be performed while a system is under certification based on credible failure mechanisms of the pressure system to ensure mechanical integrity of the pressure system is within acceptable limits set forth during initial certification.

A.12 Maximum Allowable Working Pressure –The pressure at a coincident temperature to which a boiler, pressure vessel or pressure system can be subjected to without exceeding the maximum allowable stress of the material or listed pressure-temperature rating.

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A.13 Maximum Design Pressure – The pressure used in the design of a boiler, pressure vessel or pressure system for the purpose of determining the minimum physical characteristics of the different pressure zones of a pressure vessel or pressure system.

A.14 Maximum Expected Operating Pressure – The pressure at the coincident temperature to which a boiler, pressure vessel or pressure system operates under a non-failure condition. This pressure is not to exceed the maximum allowable working pressure.

A.15 Modification - Any change to a PVS, including, but not limited to, addition or deletion of components, rerouting of components, or replacement of components with those of a different size, type, or manufacturer, is considered to be a modification.

A.16 Normal Operating Pressure – The pressure of a vessel or system at which it typically operates. This pressure is not to exceed the maximum allowable working pressure, and it is usually kept at a suitable level below the setting of the pressure relief devices to prevent their frequent opening. (A sustained or steady state condition that is a stable mode of operation of the system.)

A.17 Non-Destructive Examination (NDE) – The application of technical methods to examine materials or components in ways that do not impair future usefulness and serviceability in order to detect, locate, measure, and evaluate flaws; to assess integrity, properties, and composition; and to measure geometrical characteristics.

A.18 Non-Critical PVS – PVS governed by national codes and standards except as supplemented with unique NASA testing, operations, maintenance, inspection and personnel licensing requirements contained in NASA-STD-8719.17 and this document that is not considered critical PVS.

A.19 Non-Permanent Flex Hose - Flex Hose that is a non-permanently installed and assigned, non-dedicated flex hose whose installation is authorized and controlled by an operations procedure. Hose and certification requirements will be established by the controlling procedure.

A.20 Permanent Flex Hose - Flex Hose is a permanently-dedicated hose whose installation and placement are indicated by design-controlled engineering drawings. Once installed, the flex hose is considered to be an integral part of that installation. Permanent hoses have an assigned drawing reference designator. Permanent hoses are to be accepted and certified as part of the overall pressure system per NASA-STD-8719.17.

A.21 Permit Plan – A lab specific plan for components and assemblies that frequently change configuration but are still within the scope of the NASA-STD-8719.17 and require ISI and approval by the PSM for use on center.

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A.22 Pressure Systems Manager – The person responsible for implementation of NPD 8710.5, NASA Safety Policy for Pressure Vessels and Pressurized Systems, and NASA-STD-8719.17 at a NASA facility.

A.23 PVS Operator – Personnel that are properly trained and certified to operate PVS at GSFC. The PVS operator may also serve as the PVS owner (See PVS Owner).

A.24 PVS Owner – The management of the organization responsible for the PVS as defined in NPD 8710.5, NASA Safety Policy for Pressure Vessels and Pressurized Systems. The PVS owner may also serve as the PVS operator (See PVS operator).

A.25 Repair – The process of restoring a component or system to a safe and satisfactory condition such that the previously existing design requirements are met.

A.26 Replacement – A type of repair completed by the fabrication and installation of spare or renewal components, appurtenances, and subassemblies, or parts of a component or system.

A.27 Stored Energy – The energy stored in a fluid under pressure due to its compressibility.

A.28 Temporary PVS – A PVS that is assembled and used on center for no more than 180 days and has received approval for use by the PSM.

A.29 Transient PVS – A PVS that is assembled off center and is used on center for no more than 180 days.

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Appendix B – Acronyms

API	American Petroleum Institute
ASTM	American Society for Testing and Materials
ASME	American Society of Mechanical Engineers
ASNT	American Society for Nondestructive Testing
AWWA	American Water Works Association
BPS	Brazing Procedure Specification
BPQ	Brazer Performance Qualification
CGA	Compressed Gas Association, Inc.
CM	Configuration Management
COTS	Commercial off the Shelf
DOT	U.S. Department of Transportation
FMD	Facilities Management Division
GB	Greenbelt
GPR	Goddard Procedural Requirements
GSFC	Goddard Space Flight Center
ISI	In-Service Inspection
LN	Liquid Nitrogen
MDR	Manufacturer's Data Reports
NCS	National Consensus Codes and Standards
NDE	Nondestructive Examination
NDT	Nondestructive Testing
NRRS	NASA Records Retention Schedules
O&M	Operations and Maintenance
OEM	Original Equipment Manufacturer
OSHA	Occupational Safety and Health Administration
P&ID	Piping and Instrumentation Diagram
PP	Permit Plan
PQR	Procedure Qualification Record
PRD	Pressure Relief Device
PSM	Pressure Systems Manager
PTFE	Polytetrafluoroethylene
PVS	Pressure Vessels and Pressurized Systems
RAC	Risk Assessment Code
TA	Technical Authority
VR	Valve Repair
WFF	Wallops Flight Facility
WPQ	Welder Performance Qualification
WPS	Welding Procedure Specification

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Appendix C - Documentation Requirements Specific to GSFC PVS

The following documentation for the applicable PVS to be provided to the PSM prior to placing the component or system in service. For all Classes of PVS, Manufacturer's O&M manuals to be provided where applicable.

ASME Code Compliant Pressure Vessels

Manufacturer's Data Reports (MDR) for:

1. Section VIII, Division 1 Vessels: ***MDR Form U-1 or U-1A, as applicable.***
2. Section VIII, Division 2 Vessels: ***MDR Form A-1***
3. Section VIII, Division 3 Vessels: ***MDR Form K-1***
4. Section X, Fiber-Reinforced Plastic Pressure Vessels: ***MDR Form RP-1 or RP-3, as applicable.***

ASME Code Compliant Pressure Piping

1. Provide the engineering design¹ including:
2. Engineering Design calculations
3. Design and operating conditions
4. Material and Component Specification (ASTM or ASME or ANSI)
5. Material certifications
6. Pipe/tubing Size
7. Pipe/tubing Wall thicknesses
8. Pipe/tube fitting type and class (socket weld, butt weld, threaded, mechanical (swage), etc)
9. Manufacturer catalog sheets with the following information:
 - a. Valve type, manufacturer, model number, material of construction (body, stem, seat(s)), pressure and temperature rating
 - b. Overpressure protection: Manufacturer, model number, type, size, capacity, set point, seat material
 - c. Pressure Regulators: Manufacturer, model number, type (single stage, dual stage), material, size, max inlet pressure, max outlet pressure
 - d. Pressure gauges: Manufacturer, model number, inlet size, range
10. As-built P&ID or manufacturer drawings

1 *Engineering Design* is defined by ASME B31.3, Process Piping, as the detailed design governing a piping system, developed from process and mechanical requirements, conforming to Code requirements, and including all necessary specifications, drawings, and supporting documents.

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11. Welding Procedure Specification (WPS) or Brazing Procedure Specification (BPS), including applicable Procedure Qualification Record (PQR).
12. Copy of welder performance qualification (WPQ) or brazer performance qualification (BPQ).
13. Record of Code-required NDE
14. Record of Code-required pressure test

Other Code Compliant Pressure Vessels and Piping Systems

1. Documentation designating the Code of Record (American Petroleum Institute (API), U.S. Department of Transportation (DOT), Compressed Gas Association (CGA), American Water Works Association (AWWA), etc.) used for design; materials; fabrication and assembly; and inspection, examination, and testing, together with the design and operating conditions.
2. Manufacturer's O&M manual, if applicable
3. Material and Component Specification (ASTM or ASME or ANSI)
4. Pipe/tubing and/or Vessel Size
5. Pipe/tubing and/or Vessel Wall thickness
6. Pipe/tube fitting type and class (socket weld, butt weld, threaded, mechanical (swage), etc)
7. Valve type, manufacturer, model number, material of construction (body, stem, seat(s)), pressure and temperature rating
8. Overpressure protection: Manufacturer, model number, type, size, capacity, set point, seat material
9. Pressure Regulators: Manufacturer, model number, type (single stage, dual stage), material, size, maximum inlet pressure, maximum outlet pressure
10. Pressure gages: Manufacturer, model number, inlet size, range
11. As-built P&ID
12. Welding Procedure Specification (WPS) or Brazing Procedure Specification (BPS), including applicable Procedure Qualification Record (PQR).
13. Copy of welder performance qualification (WPQ) or brazer performance qualification (BPQ).
14. Record of Code-required NDE
15. Record of Code-required pressure test

Non-Code PVS

PVS that do not meet all of the requirements of applicable codes, standards, guides, and regulations are classified as Non-Code PVS. Since the degree of noncompliance varies from system to system, documentation requirements are to be determined on a case-by-case basis. In all cases, provide the listed information to the PSM prior to Certification.

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Non-Code PVS are only to be certified and allowed to operate if:

1. A documented risk and hazard assessment has been performed,
2. The Owner acceptance of residual risk has been documented, and
3. Center approval has been formally documented by means of a variance in accordance with NASA-STD-8719.17 and GPR 1400.1.

In addition to the documentation requirements delineated above, the following is to be provided to the PSM prior to Certification. To the extent possible, Code design and construction techniques are to be utilized on non-code PVS, in particular through the use of:

1. Documented Code material, i.e., material whose specifications and grades are approved for use by the Code that would otherwise apply to construction.
2. Documented components, (i.e. valves, fittings, elbows, etc.) that are certified to standards approved for use by the Code that would otherwise apply.
3. Documented Code-certified welding processes, personnel, and “U” authorized shops (pressure vessels only) that meet all applicable ASME Quality Assurance and certification requirements for Code construction

Note: NASA fabrication shops that do not possess an ASME “U” authorization (for pressure vessel fabrication), regardless of individual personal training, qualifications, and certifications, are not be considered equivalent to Code certified shops and hence can only perform Non-Code pressure vessel welding.

4. Documented assurance of material design factors of safety of no less than a Code PVS.

Ground Support Equipment (GSE)

1. Documentation designating the Code of record used for design; materials; fabrication and assembly; and inspection, examination, and testing.
2. Design and operating conditions
3. Material and Component Specification (ASTM or ASME or ANSI)
4. Pipe/tubing and/or Vessel Size
5. Pipe/tubing and/or Vessel Wall thickness
6. Pipe/tube fitting type and class (socket weld, butt weld, threaded, mechanical (swage), etc)
7. Valve type, manufacturer, model number, material of construction (body, stem, seat(s)), pressure and temperature rating.
8. Overpressure protection: Manufacturer, model number, type, size, capacity, set point, seat material
9. Pressure Regulators: Manufacturer, model number, type (single stage, dual stage), material, size, max inlet pressure, max outlet pressure
10. Pressure gages: Manufacturer, model number, inlet size, range

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11. Welding Procedure Specification (WPS) or Brazing Procedure Specification (BPS), including applicable Procedure Qualification Record (PQR).
12. Copy of welder performance qualification (WPQ) or brazer performance qualification (BPQ).
13. Record of Code-required NDE
14. Record of Code-required pressure test
15. As-built P&ID

Excluded PVS

Documentation requirements are to be established on a case-by-case basis, and will generally include information necessary to validate exclusion. Excluded systems are subject to the requirements of OSHA, the applicable NCS, and NASA safety requirements. Operation of excluded Commercial off-the-Shelf (COTS) systems are to be within manufacturers placard limitations.

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Appendix D – Excluded System Clarification

Each excluded PVS will be required to be evaluated and documented prior to PSM acceptance of exclusion. PSM may issue an exclusion tag to identify specific excluded PVS as practical.

NASA and Non-NASA Owned DOT Liquid Cylinders (Dewars)

NASA Owned DOT liquid cylinders of both high and low pressure are excluded from certification. This does not exclude the primary safety device as defined in CGA P-12, paragraph 4.2, from In-Service Inspection or testing. Primary relief devices on NASA owned DOT liquid cylinders are to be maintained and tested in accordance with NASA-STD-8719.17 and NB-23. Each NASA owned DOT liquid cylinders will be issued an excluded system number, excluded tag and tracked in the PVS configuration management system.

Non-NASA owned DOT liquid cylinders are excluded from certification. These DOT liquid cylinders are the responsibility of the vendor to ensure proper maintenance and testing is performed in accordance with applicable national codes and standards.

150 PSIG and Below Exclusion Clarification

NASA-STD-8719.17 calls out specifics for the exclusion of certification of certain PVS that meet the requirements of operating at less than 150 psig, ambient temperature, inert gas and no greater than 1/2 inch. Based on calculations performed by the PVS group and approved by the PSM, this category exclusion has been extended to include piping and tubing operating under the previously mentioned conditions up to 2 inches in diameter.

Exclusion from certification should not be interpreted as exclusion from verification. Although PVS or portions of PVS meet these criteria, the PVS or portions of the PVS are still required to be verified for operation within the design limits and must also be properly protected from over pressurization as in accordance with NASA-STD-8719.17 and ASME B31.3.

COTS Items

Laboratory COTS items include vacuum furnaces, dry boxes, mass spectrometers, weld machines or other preassembled items intended for use in laboratory settings. COTS items are to be maintained by the manufacturer or in accordance with manufacturer recommendations. Equipment that may be pressurized above its MAWP for any reason by the fluid delivery system are required to have appropriate overpressure protection installed and the fluid delivery system is required to be certified by the PSM in accordance with NASA-STD-8719.17.

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COTS prepackaged hydraulic power systems and oil lubrication systems may be excluded provided they are used as specified/recommended by the manufacturer, are used within rated capacity, and are used and protected against overpressure as per the manufacturer's recommendations, service intervals, etc. This exclusion does not exempt (a) any interface joints to non-COTS equipment from being qualified in accordance with the applicable national piping code and (b) any external PVS not integral to the OEM COTS system.

Hydraulic Power Systems and Oil Lubrication Systems with design temperatures not exceeding 160°F and design pressure/MAWP not exceeding 150 psi (typically, return side piping). This exclusion does not exempt (a) any constituent piping and piping welds from being qualified in accordance with the applicable national piping code, (b) any system pressure vessels from fully complying with appropriate NCS (e.g. ASME Section VIII B&PV code) (c) periodic retesting of components in accordance with other sections of this document and NASA-STD-8719.17.

Air Pad Manifolds/Air Bearings

Air bearings and air pad manifolds are excluded from certification provided they are installed and maintained in accordance with standard practices. Based on stored energy not exceeding the equivalent of 2 inch piping at 150 psig and 10 feet in length, which equals roughly 7,500 ft-lbs, air pad manifolds and air bearings are considered to be excluded from certification.

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CHANGE HISTORY LOG

Revision	Effective Date	Description of Changes
Baseline	03/12/04	Initial Release
A	12/29/04	As directed during the FY04 Center Rules Review, the Responsible Office modified this document to remove requirements that were no longer needed and to clearly distinguish requirements from supporting information. Administrative changes were made throughout to correct responsible organization names and codes, and to retitle Goddard Procedures and Guidelines (GPG) to Goddard Procedural Requirements (GPR). All changes were reviewed and approved by the Goddard Quality Management System Council (QMSC).
A	10/26/05	Administrative change – Directive was changed to reflect a change in the responsible organization from code 540, the Mechanical Systems Division, to code 250, the Safety and Environmental Division.
B	07/16/09	Return Responsible Office to 540/Mechanical Systems Division from 250/Safety and Environmental Division. In addition, the document was updated in its entirety to reflect requirements stipulated in NASA-STD-8719.17.
B	02/25/14	Administratively extended for 1 year.
B	07/07/15	Administrative change and extension – Directive was changed to reflect a change in the responsible organization from Code 540, the Mechanical Systems Division, to Code 360, the Safety Division. In addition, directive will be extended for 1 year.
C	09/15/15	Administratively revised to add reference documents 500-PG-8710.3.1 and 800-PG-8710.3 and Chapter 4 Procedural Guidelines.
C	07/28/16	Administrative change and extension – Updated template and extended for 1 year.
C	06/15/17	Administrative change and extension – Updated template and extended for 1 year.
D	06/18/18	Total rewrite.

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